Joint Center for
Intelligent Spatial Computing

Visualizing 5D dust storm data

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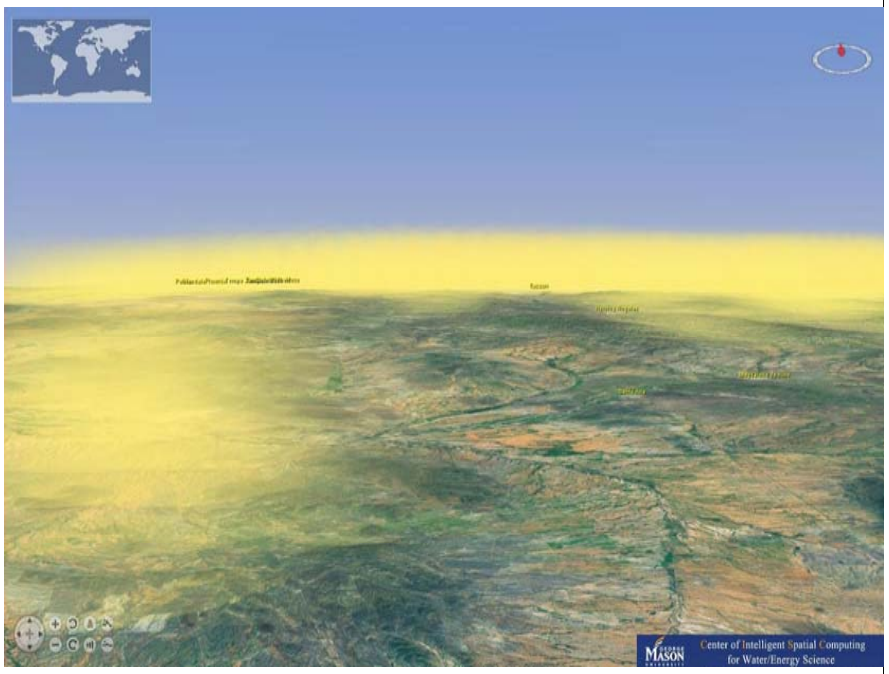
Dust Storms Forecasting & Visualization

- **Objectives**
  1. Provide timely forecasting of dust storm for public health emergency responses
  2. Provide an intuitive interface for decision makers

- **Enabling Computing Technologies**
  1. Cloud Computing as an advanced cloud computing platform to support simulation and forecasting.
  2. 4D/5D Vis Tool to render the data.



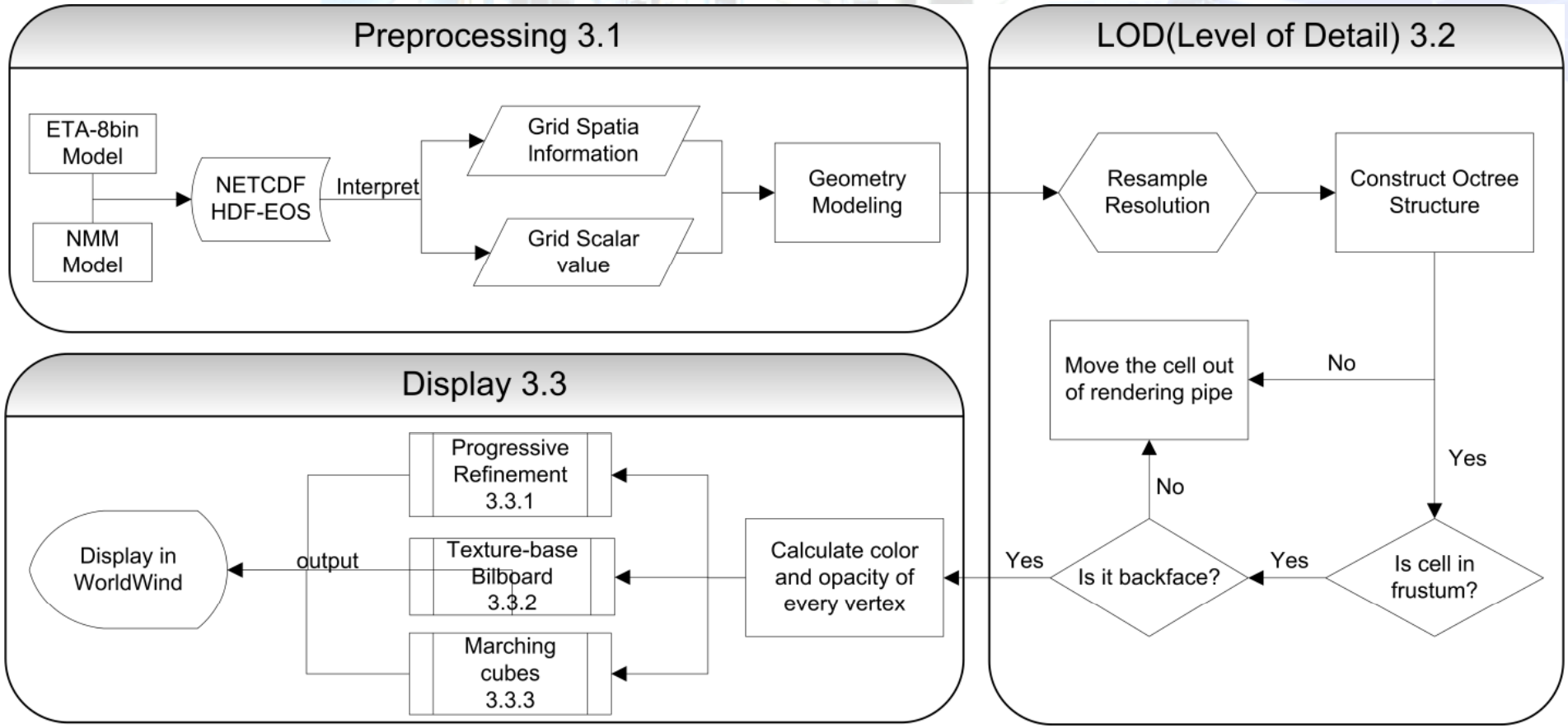
Xie, J., Yang, C., Zhou, B., and Huang, Q., 2010. High performance computing for the simulation of dust storms. Computers, Environment, and Urban Systems, 34(4):278-290.

Challenges

1) Develop an interactive tool to promote the understanding of large scale environmental phenomena by extracting data into a scientific format ready for rendering purposes;
2) Visualize these datasets with our expanded functions and algorithms based on World Wind to facilitate scientific exploration of relevant phenomena, such as dust storms; and
3) Optimize the implementations to improve the overall efficiency when dealing with large volume data. Dust storm was chosen as an example to demonstrate the usages of our solution.

Li J., et al., 2011. Visualizing dynamic geosciences phenomena using an octree-based view-dependent LOD strategy within virtual globes, Computer & Geosciences, doi:10.1016/j.cageo.2011.04.003

Visualization System Architecture



GEORGE MASON
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Suggestions for 5D Visualization

Representation

•**Representation modes** that can best depict the phenomena and illustrate the context.

•**Geometrical units**, for example, elements in the 5D matrix, could be used to construct a library of representation geometries.

•**Coloring** is an option to represent different phenomena with different purposes.

Data access and management

•**Data storage** that can handle large data is critical in improving the overall visualization performance.

•**Preprocessing** the data for visualization can avoid excessive external communication and reduce the frequent data exchange between hardware.

•**Indexing** methods are critical to reorganize data for faster data access and smooth animation.

Rendering and algorithms

•**Algorithm selection** should be provided.

•Culling mode is one of the key strategies to improve the 5D visualization performance by removing invisible objects in rendering pipe.

•**Rendering engine** has been playing an important role in 5D data visualization.

Other issues

•**Leveraging CPU and GPU capabilities** and full capability of other hardware, including professional graphics card, CPU computing capabilities and GPU rendering capabilities, is a good way to enhance the rendering capabilities.

•**Raster and vector**. Raster data and vector data are the two major data types in spatial sciences. Algorithms for visualizing the phenomena described by two different data types can be roughly divided into raster based rendering techniques and vector based rendering techniques and determined by the rendering solutions.

•**Systematic integration**. Since visualizing 5D environmental data is an integrated process, scientists should consider the following items: a) Interaction. b) Distribution strategy. c) Interoperability, extensibility and reusability. ESIP Visualization Cluster, Webinar, Dec.12, 2011

Sponsors and Collaborators